

EXHIBIT S



**UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

TQ DELTA, LLC,

Plaintiff,

v.

COMMSCOPE HOLDING COMPANY,
INC., COMMSCOPE, INC., ARRIS US
HOLDINGS, INC., ARRIS SOLUTIONS,
INC., ARRIS TECHNOLOGY, INC., and
ARRIS ENTERPRISES, LLC,

Defendants.

Civil Action No.: 2:21-cv-310



**RESPONSIVE EXPERT REPORT OF DR. LEONARD J. CIMINI, JR. ON THE NON-
INFRINGEMENT OF THE FAMILY 1 AND 4 PATENTS**

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having ordinary skill in the art on the priority date of the '008 patent, considering the context of the claims themselves, the specification, the figures, the prior art, and the prosecution history. Consistent with these constructions and interpretations, I have considered the claims in light of the ordinary meaning of the claims based on the perspective of one of skill in the art and consistent with my experience in the field.

IX. ANALYSIS OF NON-INFRINGEMENT

1. Summary of Opinions

41. In my opinion, TQ Delta's expert reports on infringement have not shown that the CommScope Accused Products infringe claim 36 of the '686 patent ("Asserted Family 1 Claim") or claim 14 of the '008 patent ("Asserted Family 4 Claim"). It is also my opinion that the CommScope Accused Products do not literally infringe claim 36 of the '686 patent or claim 14 of the '008 patent.

42. To the extent that TQ Delta's experts present opinions that the Asserted Family 1 Claim and the Asserted Family 4 Claim are essential to the VDSL2 standard, G.993.2, I disagree. TQ Delta's experts have failed to show that each limitation of each claim is found in the standard, and it is my opinion that each limitation is not found in the standard, nor does any device complying with G.993.2 necessarily have to use the Asserted Family 1 Claim or the Asserted Family 4 Claim.

43. I have reviewed the tests conducted by Dr. Todor Cooklev and his expert report regarding his tests. Dr. Cooklev's tests suffer from a number of flaws that make them unreliable. In addition, Dr. Cooklev's tests do not answer the question of whether the products practice each limitation of the claims.

2. VDSL2 Technology and Standard Essentiality

44. In his report, Dr. Madisetti presents a description of what he terms "DSL

Technology Accused of Infringing the Asserted Claims,” in which he describes DSL technology, including VDSL2. *See* Madisetti Report, Section VIII. Similarly, Dr. Brody presents a description of what he terms “Diagnostic Mode in the VDSL2 Standards.” *See* Brody Report, Section X. To the extent that TQ Delta’s experts contend that any product that practices the VDSL2 standard necessarily infringes the Asserted Family 1 Claim or the Asserted Family 4 Claim, I disagree, and further, I disagree that TQ Delta’s experts have presented evidence that this is the case. Below, I note examples of disagreements that I have with TQ Delta’s experts’ characterization of DSL and VDSL2 technology.

45. First, with respect to what TQ Delta’s experts term the “VDSL2 Standard” itself, I note that it is a Recommendation. *See* G.993.2 (12/2011) at p. ii. It explicitly states that “the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability).” *Id.* The primary purpose of any standards document developed or disseminated by a standard-setting body is to ensure interoperability between products made and sold by multiple different manufacturers or service providers. A standards document is not intended to be a set of instructions on how to build a product. Standards documents such as VDSL2 list a number of capabilities and features, some of which are mandatory, others that are optional.

46. A standards document does not necessarily dictate every facet of the operation of a product, even when that product complies with the standard. Because of this, the standard may explain what a device must do in order to interoperate with other devices, but will be silent on many details and features of the internal operation of a device. As a result, if a device is standards-compliant, or advertises that it is standards-compliant, the internal operation of that device may vary as between other standards-compliant devices.

47. In addition, because the standards themselves are focused on interoperability,

there may be functions within a product that are opaque to a network or other products that any given product is to interoperate with. A standard may describe certain features or requirements for the internal operations of a device; however, there may be multiple ways, including ways that are not dictated by the standard, that a device can perform a function such that it interoperates with other purportedly standards-compliant devices. Put differently, the device interoperates with other standards-compliant devices, but does not perform certain internal operations in the same manner as is set forth in the standards. Such changes are immaterial to the other devices in the network, because the device is perfectly capable of interoperating with them, regardless of whether it meets each part of the standard, exactly.

48. At paragraph 104 of his Opening Report, Dr. Madisetti purports to describe an example of a network in which customer premises equipment (CPEs), such as the CommScope Accused Products, are deployed. He also provides a figure within paragraph 104 that purports to describe a network where the 2Wire Accused Products (I assume he meant CommScope Accused Products) would be found. I note that in practice, the setup of the network, as well as multiple details of how a CPE operates, are determined by the network operator, not a provider of CPEs, such as CommScope. This includes the kind of communications (for example, VDSL2, ADSL2/2+, or ADSL) that will be used on a connection. That, and other functions, are determined by the network operator.

49. TQ Delta's experts note that CommScope documentation, such as for the BGW210-700 accused product states that the product must "[REDACTED]" or that the "[REDACTED]"
 [REDACTED]
 See Madisetti Opening Report, ¶¶ 150-152; Brody Opening Report, ¶¶ 134, 141. Dr. Madisetti also cites to [REDACTED]

Id. at ¶ 155. Similarly, Dr. Brody asserts that the Broadcom chips in the accused products “include a standard compliant implementation of the VDSL2 standard.” *See* Brody Opening Report, ¶ 130. To the extent that Dr. Madisetti and Dr. Brody rely on these statements to show that the Accused Products infringe, I disagree. As I describe below, neither the Asserted Family 1 Claim nor the Asserted Family 4 Claim is essential to G.993.2, so it is not the case that the CommScope Accused Products must use the alleged inventions in the Family 1 and 4 asserted claims in order to comply with G.993.2.

a. VDSL2 Initialization Messages

50. TQ Delta's experts rely on a number of initialization messages for their infringement opinions. Dr. Madisetti purports to provide a description of those messages, and that initialization process, at Section VIII.B of his report. *See* Madisetti Report, ¶¶ 107-129. Similarly, Dr. Brody purports to provide a description of the same at Section X of his report. *See* Brody Report, ¶¶ 66-85.

51. These messages, however, can only be sent and received when a CPE is connected to a network, which is done by a network operator. The initialization messages are part of an initialization procedure described in Section 12 of G.993.2. As Dr. Brody and Dr. Madisetti have stated, the VDSL2 transceiver must go through the initialization process described in Section 12 before it can communicate data. *See* Brody Report, ¶ 67; Madisetti Report, ¶ 107; *see also generally* G.993.2, Section 12.1.3. I understand that CommScope only makes CPEs—it does not make or sell DSLAMs, nor does it operate a network that uses DSL.

52. The initialization messages relied on by TQ Delta's experts are exchanged at a different time than user data, during a training phase. G.993.2 also describes how the transceiver does not communicate user data during initialization, as shown in the link state diagram at Fig. 12-1, depicted below.

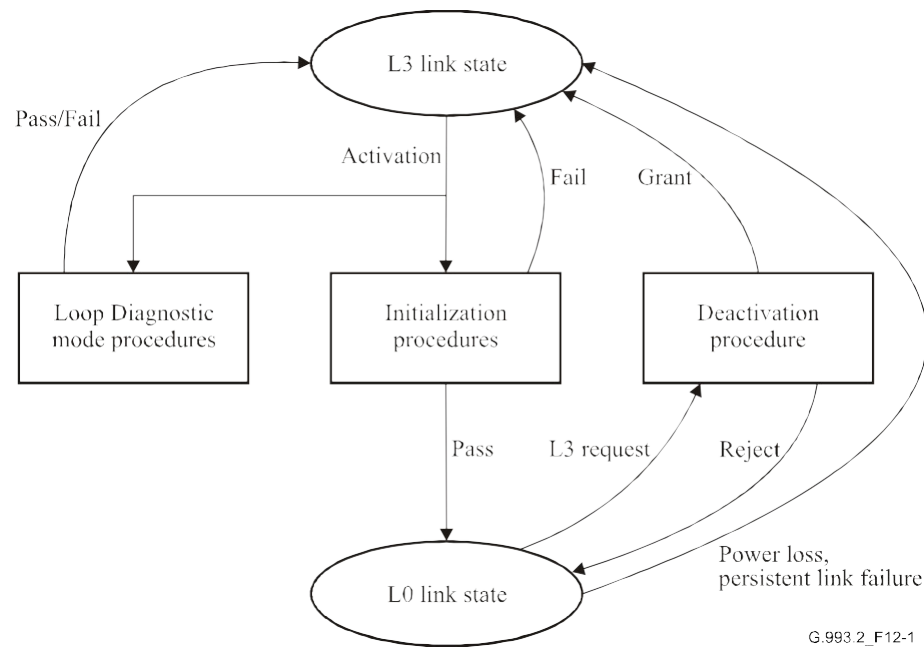


Figure 12-1 – VDSL2 link states and link state diagram

G.993.2 states: “L3 is the link state where the VTU is provisioned through a management interface for the service desired by the operator. In this link state, both the VTU-O and VTU-R do not transmit any signal.” G.993.2 at p. 164; *see also id.* at Section 12.1.1, Fig. 12-1 (VDSL2 link states and link state diagram). G.993.2 further explains that “L0 is the link state achieved after the initialization procedure has been completed successfully by both VTUs.” *Id.* In this way, the initialization messages that TQ Delta’s experts rely on for its infringement read are only generated, received, sent, and processed after a CommScope Accused Product is physically connected to a network, and some action has been taken in order to provision the CommScope Accused Product.

b. VDSL2 Quadrant Scrambler

53. G.993.2 also describes a quadrant scrambler, on which TQ Delta’s experts rely to try to show infringement by the CommScope Accused Products. *See Madisetti Report*, ¶¶ 180-86. The initialization messages on which TQ Delta relies for its infringement read are subjected

to the operation of the quadrant scrambler.

54. The quadrant scrambler of VDSL2 requires that the constellation points that are used in the transmission signal must comply with Table 12-70:

Table 12-70 – Pseudo-random transformation

d_{2n}, d_{2n+1}	Angle of rotation	Final coordinates
0 0	0	(X, Y)
0 1	$\pi/2$	$(-Y, X)$
1 1	π	$(-X, -Y)$
1 0	$3\pi/2$	$(Y, -X)$

G.993.2 at Section 12.3.6.2. In order for a transmitted signal to be decoded by a receiving transceiver, the transmission signals need to be consistent with this chart.

55. G.993.2 also defines a bit generator that is used to generate the pseudo-random number sequence that is used referenced in Table 12-70. *Id.*, Fig. 12-12. The PRBS generator of G.993.2 generates a sequence of 2-bit pseudo-random numbers from the set (0,0), (0,1), (1,1), and (1,0). *See id.* Table 12-70 shows the corresponding phase shift for each of the four possible 2-bit pseudo-random numbers, and the corresponding coordinates of the constellation point.

56. To one of ordinary skill in the art, G.993.2 describes (1) how to generate a pseudo-random number sequence; (2) the relationship between the data bits for a given carrier, and the constellation point used for transmission based on 2-bit pseudo-random number. G.993.2 does not mandate any specific ways of generating the pseudo-random number sequence (aside from an equation it must satisfy), or how to generate the constellation points for transmission.

57. The quadrant scrambler of G.993.2 operates in two modes. The first is Reset Mode, in which “the scrambler shall be reset at the beginning of every symbol period.” G.993.2,

at Section 12.3.6.2.1. The second is free-running mode, where “the scrambler shall not be reset at the beginning of each symbol period, but instead shall continue running from one symbol to the next.” *Id.* at Section 12.3.6.2.2. Importantly, the quadrant scrambler operates only during initialization, not during Showtime, when user information is transferred over the DSL connection. And in turn, the transceiver only operates, and the quadrant scrambler only operates, after a CPE is connected to a network and central office equipment, and provisioned by the network to operate in VDSL2 mode.

c. The Asserted Claims Are Not Standard Essential.

58. I disagree with TQ Delta’s experts that the Asserted Family 1 and Family 4 Claims read on the mandatory portions of the VDSL2 standard. I understand that, to show that a claim is essential to a standard, each limitation of claim must be required to practice the standard. I disagree with Dr. Madisetti’s statement that “[b]ecause the Asserted Claims read on those mandatory portions of the VDSL2 standard the Accused Products necessarily infringe the asserted claims.” Madisetti Report, ¶ 185. Similarly, I disagree with Dr. Brody’s statement that “[b]ased on its VDSL2 capabilities...the BGW210 infringes claim 36 of the ’686 Patent.” Brody Report, ¶ 188. Neither expert has provided evidence to show this, and for that reason, TQ Delta and its experts have failed to demonstrate that claim 36 of the ’686 patent or claim 14 of the ’008 patent is essential to G.993.2. Therefore, TQ Delta’s reliance on CommScope’s representations that the CommScope Accused Products are compliant with G.993.2 does not show infringement.

59. First, as I mentioned above, a standard is generally a set of requirements that a product or service needs to comply with in order to interoperate with products and services from other suppliers. G.993.2 does not provide instructions or a guide on how to build customer premises equipment, and indeed, many details of the implementation are up to the user. For example, each of the claims requires a “transceiver” or a “first transceiver.” G.993.2 does not

provide instructions to one of ordinary skill in the art, to build a transceiver.

60. Second, in my experience and in the experience of one of ordinary skill in the art, a representation that a product is compliant with a standard means that the product can interoperate with other products and services that are also compliant with the same standard. The standard may not require that a functionality must be executed in a specific way, and multiple ways of achieving the same functionality may be possible. The product may, or may not, comply exactly with all provisions in a standard, regardless of whether those provisions are mandatory or optional. This is so because standards contain functions that are opaque to the outside world. An example of this is the quadrant scrambler described in Table 12-70 of G.993.2. Multiple ways of achieving this function are possible.

61. Dr. Madisetti further states that “the claim limitations as construed map to mandatory functionality relating to the transmission of SOC messages in accordance with the scheme set forth in Tables 12-38, 12-68, and 12-69 of the VDSL2 standard.” Madisetti Report, ¶ 179. The SOC messages are described nowhere in the Asserted Family 4 Claim. Each of the SOC messages on which Dr. Madisetti and TQ Delta’s experts rely for their infringement read are generated within the transceiver.

62. Dr. Madisetti also relies on the quadrant scrambler described in G.993.2 as demonstrating that the Asserted Family 4 Claim is standard essential. Madisetti Report, ¶ 181. I disagree that the Asserted Claims Asserted Family 4 Claim is required to implement the quadrant scrambler of G.993.2. Specifically, Claim 14 of the ’008 Patent requires a transceiver capable of “computing a phase shift for each carrier signal based on [a value determined independently of any bit value] associated with that carrier signal.” The VDSL2 standard, however, does not require “computing” a phase shift for each carrier signal. Instead, the VDSL2 standard provides

a table whereby a carrier signal may be rotated, i.e., phase shifted. G.993.2 at Table 12-70.

G.993.2 merely supplies the conditions that the quadrant scrambler must comply with so that messages can be interpreted properly by the transceiver on the receiving end of the message, it does not require computing a phase shift for each carrier signal, as I explained above at Section IX.2.b, and below with respect to those limitations of the claims. Because the VDSL2 standard provides the amount of the phase shift for each carrier signal, the standard does not require “computing” of any phase shift.

63. In addition, I note that each of the CommScope Accused Products can operate in other modes, and support other standards in addition to VDSL2. Each of the Accused CommScope Products supports, among other transmission schemes, ADSL, ADSL2, and ADSL2+ modes. *See, e.g.*, BGW210-700 Data Sheet (COMMSCOPE012891-COMMSCOPE012893) at COMMSCOPE012892; 5031NV Data Sheet (COMMSCOPE013310-COMMSCOPE013311) at COMMSCOPE013311; 5168NV Data Sheet (COMMSCOPE013312-COMMSCOPE013313) at COMMSCOPE013312; 5268AC Data Sheet (COMMSCOPE013314-COMMSCOPE013319) at COMMSCOPE013317. I also note that, because the Accused CommScope Products are CPEs, they must be connected to the network of a DSL service provider. The DSL service provider (not CommScope) selects the mode in which the Accused CommScope Products will operate in any particular context. And, for example, if the DSL service provider selects ADSL, ADSL2, or ADSL2+ as a mode of operation, the SOC messages on which TQ Delta relies for its infringement read, as well as the methods of phase scrambling that they also rely on, are not performed.

3. Testing and the Expert Reports of Dr. Todor Cooklev

64. I have reviewed Section VII, and the corresponding exhibits thereto, of the Opening Expert Report of Dr. Todor Cooklev, Ph.D. (“Cooklev Report”) relating to the testing

of the CommScope Accused Products. Below, I detail a number of issues with Dr. Cooklev's testing.

a. The Family 1 Patent

65. Dr. Cooklev's test procedures can be generally described as follows: (1) setup and configure the Accused CommScope Product connected to a DSLAM, (2) inject a significant amount of noise using an impairment generator at both ends, (3) force the VDSL2 connection between the Accused CommScope Product and the DSLAM to retrain, (4) manually send a command from the DSLAM to the CPE to initiate a Loop Diagnostic Mode, and (5) capture certain information about the messages transmitted between the CPE and the DSLAM. *See* Cooklev Report, ¶¶ 659-663, Ex. 3 at 9-12.

66. I note that Dr. Cooklev's testing does not show that the 5168NV would ever enter the loop diagnostic mode as it is deployed by CommScope customers. The 5168NV only entered the loop diagnostic mode because Dr. Cooklev forced it to. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

67. Additionally, I note that Dr. Cooklev performed no testing at all on any CommScope Accused Product besides the 5168NV. *See, e.g.*, Cooklev Report, Ex. 3 at 5.

b. The Family 4 Patent

68. Dr. Cooklev's test procedures can be generally described as follows: (1) setup and configure the Accused CommScope Product connected to a DSLAM, (2) inject a significant

Report, ¶¶ 756, 774.

4. Claim 36 of the '686 Patent

In my opinion, TQ Delta has not shown that the CommScope Accused Products infringe claim 36 of the '686 Patent. It is also my opinion that the CommScope Accused Products do not infringe claim 36 of the '686 Patent, at least for the reason that claim 36 of the '686 patent is not essential to the G.993.2 standard as I explain above at Section IX.2.c. In addition, Dr. Brody's opinions on infringement are subject to multiple failures of proof, which I detail below.

- a. "instructions that when executed transmit from the transceiver a diagnostic message using multicarrier modulation with DMT symbols that are mapped to one bit of the diagnostic message,"

79. In my opinion, the CommScope Accused Products do not meet this limitation.

80. In my opinion, a person having ordinary skill in the art would interpret the phrase "transmit from the transceiver a diagnostic message using multicarrier modulation with DMT symbols that are mapped to one bit of the diagnostic message" in one of the following three ways:

- The diagnostic message includes multiple DMT symbols and each DMT symbol includes only one bit;
- The diagnostic message includes DMT symbols such that one bit is spread across two or more DMT symbols; or
- The diagnostic message includes DMT symbols such that each symbol includes only one bit and there is at least one identical symbol that includes that same bit.

81. In my invalidity report, I explained that there is no written description or enablement support in the specification of the '686 patent for the third construction. I therefore applied the prior art to the claim under the first construction and showed that the claim was obvious in view of the prior art. Below I show that under the second construction, the

CommScope Accused Products do not infringe claim 36 of the '686 patent.

82. It is my opinion that the CommScope Accused Products do not use “multicarrier modulation with DMT symbols that are mapped to one bit of the diagnostic message.” Instead, the CommScope Accused Products use multicarrier modulation that maps one bit to each DMT symbol and then repeats the DMT symbol a number of times.

83. To the extent that Dr. Brody asserts that the CommScope Accused Products infringe claim 36 because they are compliant with VDSL2, I disagree. VDSL2 does not require “multicarrier modulation with DMT symbols that are mapped to one bit of the diagnostic message.” Instead, the standard is very clear, each bit is mapped to one DMT symbol, as Dr. Brody himself highlights:

12.4.1.1 SOC message mapping during loop diagnostic mode

In order to increase the robustness of the messages exchanged during the channel discovery and training phases of the loop diagnostic mode, all SOC messages shall be sent using 1 information bit per DMT symbol, where each bit is sent 5 times in 5 consecutive DMT symbols. The mapping of the SOC bits to subcarriers during loop diagnostic mode shall be as summarized in Table 12-72.

See, e.g., Brody Report at ¶475 (citing G.993.2 at § 12.4.1.1).

84. Dr. Brody repeatedly equates mapping symbols to one bit with mapping one bit per DMT symbol and then repeating the message. Brody Report at ¶¶ 246, 250, 252. In my opinion, this is wrong.

85. As an initial matter, mapping DMT symbols to bits makes no sense. The VDSL2 transmitter is shown in Figure 10-1:

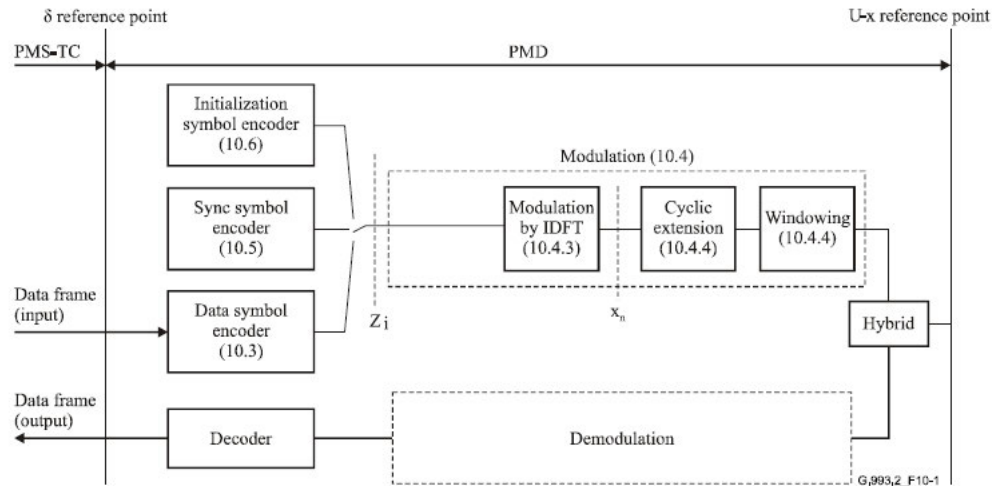


Figure 10-1 – Functional model of PMD sublayer

G.993.2 at Fig. 10-1. This figure indicates that bits are encoded either by the initialization symbol encoder, the sync symbol encoder, or the data symbol encoder. Whether one considers the digital domain or the analog domain, there is no DMT symbol until after one of these encoders. In the digital domain, the DMT symbol is what comes out of the selected one of the three encoders. That digital version is modulated by the “Modulation” block, which is what creates the analog DMT symbol that is actually launched onto the line. There is simply no way to map symbols to bits, much less to map multiple DMT symbols to a single bit.

86. Indeed, the '686 patent applicants demonstrated that they knew how to claim modulation schemes that map each bit of a message to a single DMT symbol, as described by the standard. For example, in claim 1, applicants claimed “a method of communicating diagnostic information” that included transmitting a diagnostic message “wherein...each bit in the diagnostic message is mapped to at least one DMT symbol.”

87. But even if a person having ordinary skill in the art would understand the claim to recite mapping bits to symbols, the claim either means that each DMT symbol of the diagnostic message includes a single bit, in which case the claim is simply reciting the admitted prior art

modulation technique of the ADSL standard, or the claim requires that a single bit is spread out over “DMT symbols,” i.e. two or more DMT symbols. In contrast to the latter, in the VDSL2 standard and the Accused products, each bit is mapped to a single DMT symbol and then that DMT symbol is repeated four more times.

88. Additionally, I have reviewed the expert report of Walter Overby and specifically the sections related to Loop Diagnostic Mode in response to Section VII.C.2 of Dr. Cooklev’s opening report. I understand that Mr. Overby disagrees with Dr. Cooklev’s analysis of the source code. For the reasons specified by Mr. Overby, I find that Dr. Cooklev’s analysis fails to evidence that the Accused Products infringe claim 36 of the ’686 patent. Therefore, Dr. Brody’s reliance on this analysis is in error.

89. For the reasons explained above, Dr. Brody has not shown that the CommScope Accused Products infringe claim 36 of the ’686 patent.

5. Claim 14 of the ’008 Patent

90. I note that for his opinions on infringement of the CommScope Accused Products for claim 14 of the ’008 patent, Dr. Madisetti addresses all of the CommScope Accused Products at the same time. He does not present opinions, specifically, that any particular product infringes, instead relying on the VDSL2 standard, his source code analysis, and in some places, the testing of Dr. Cooklev. I understand that each of the CommScope Accused Products uses Broadcom chips that use code from the same common codebase. I disagree, however, with Dr. Madisetti’s approach, and it is my opinion that he has not shown infringement, at least for the reason that claim 14 of the ’008 patent is not essential to the G.993.2 standard as I explain above at Section IX.2.c. In addition, Dr. Madisetti’s opinions on infringement are subject to multiple failures of proof, which I detail below.

91. In responding to Dr. Madisetti’s opinions on infringement, however, I take a